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## Lateral and anterior plating of intra-articular distal femoral fractures treated via an anterior approach

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**Abstract** Thirty-five patients with 36 displaced distal femoral fractures (16 AO-type C2 and 19 AO-type C3) were treated with an anterior approach and double plating and followed for an average of 7 (3–44) months. Bone grafting with allograft and demineralized bone matrix was used. Postoperative therapy included immediate ROM and non-weight bearing for 12 weeks. Two patients died during hospitalization and one was lost to follow-up. Reductions were near anatomic in all but three patients. Uneventful healing by 16 weeks occurred in 24/36 fractures. Double plating via the anterolateral approach minimized stripping of the medial side and improved controlled access to the distal femur.

**Résumé** Trente-cinq malades avec 36 fractures fémorales distales déplacées (16 de type AO C2 et 19 de type C3) ont été traité par un abord antérieur, une ostéosynthèse par deux plaques et ont eu un suivi de 7 mois en moyenne (3 à 44 mois). Des greffes par allogreffes et matrice osseuse déminéralisée ont été utilisées. Après l'intervention une mobilisation précoce et une décharge de 12 semaine ont été réalisées. Deux malades sont morts pendant l'hospitalisation, et 1 a été perdu de vue. La réduction des fractures était presque anatomique sauf dans 3 cas. La consolidation s'est produite sans incident en 16 semaines pour 24 des 36 fractures. L'ostéosynthèse avec 2 plaques par un abord antéro-externe minimise les délabrements internes et améliore l'accès au fémur distal.

### Introduction

Traditional techniques for treatment of AO type C fractures of the distal femur have utilized the lateral approach with soft tissue preservation. Recent trials with minimally invasive plating techniques have been reported [1, 3] but can incur greater operative times and are technically challenging. Proper use of the lateral approach can be difficult and can result in greater soft tissue dissection if not performed correctly. Although favorable results have been reported using intramedullary (IM) nailing of distal femoral fractures [4, 7], other studies have shown the IM nail to be inferior to plating with regard to mechanical properties such as stiffness [2, 5, 6]. Furthermore, IM nailing cannot be used for the more severe intraarticular fractures.

Much like the traditional lateral approach, the anterior approach permits increased reduction and placement of fixation devices, exposes only the anterior and lateral aspects of the femur, and avoids unintentional medial dissection. Furthermore, both an anterior and a lateral plate can be placed at 90° to each other to provide better structural stability; the concept is somewhat analogous to fixation of the distal humerus. In this report, we provide a descriptive analysis of our experience with double plating of the distal femur using a single anterior approach that minimizes excessive medial dissection while providing excellent exposure.

### Materials and methods

All displaced C2 and C3 (AO classification) distal femoral fractures ( $n=39$ ) were treated utilizing an anterior approach and double plating. The anterior approach uses a lateral peripatellar arthroscopy and lateral dissection of the vastus lateralis, and part of the intermedius from the femur (Figs. 1, 2, 3, and 4). The anterior dissection was limited to avoid any medial dissection not already perpetrated by the injury. Hohman and Bennett-type retractors were strictly forbidden. After articular reduction was achieved, a lateral plate (condylar or blade) and anterior plate (reconstruction or 3.5 mm dynamic compression) were placed (Fig. 5). The anterior plate was contoured to lie just next to the articular surface of

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**Fig. 1** Cutaneous location of incision



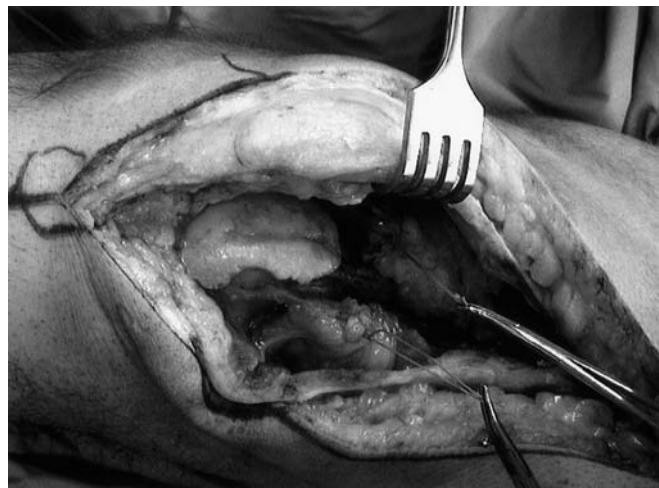
**Fig. 2** Subcutaneous exposure. Identify patellar and quadriceps tendons. Limit undermining of skin

the medial trochlea. Gentle flexion facilitated articular visualization, when needed (Fig. 6.) All open fractures were treated with aggressive debridement and antibiotic beads, with temporary external fixation followed by definitive stabilization and soft-tissue coverage within 1 week. Bone grafting with allograft and demineralized bone matrix (DBM) was used in all but eight femurs (seven patients), because of the severity of bone loss or comminution. The main technical difficulty with this exposure is proximal screw placement in the lateral plate. Because the quadriceps are split anteriorly, some of the lateral screws were placed percutaneously.

The postoperative physiotherapy included immediate ( $0^\circ$ – $30^\circ$ ) and graduated ( $15^\circ$ /10 days) motion and no weight bearing for at least 12 weeks. In the more severe cases, external fixation was maintained for 2–4 weeks, after which patients began graduated motion. In addition to demographic and routine clinical data, we analyzed fracture pattern, method of fixation, technical problems,



**Fig. 3** Lateral peripatellar incision. Note exposure of lateral condylar area

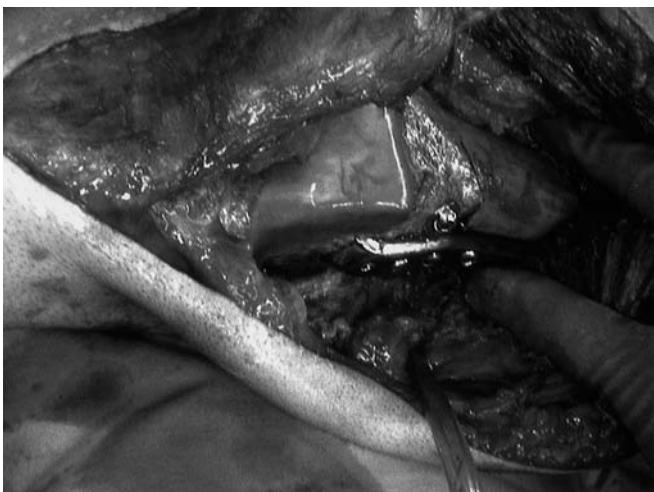


**Fig. 4** Intraarticular exposure with fracture easily identified. Identify and tag margins of suprapatellar pouch to facilitate repair during closure. This will help minimize postoperative adhesions. Note that there is no medial dissection

and complications. Healing was determined clinically and radiographically. Follow-up was performed at 2, 6, 12, 24, and 48 weeks, and then annually.

## Results

Thirty-five patients with 36 fractures were treated utilizing this approach. There were 21 men and 14 women, with an average follow-up of 7.7 (range 3–44) months. Two patients died during hospitalization, one was lost to follow-up, and two developed an infection – one of which resulted in an amputation below the knee. There were four G-I, five G-IIIA, one G-IIIB, two G-IIIC fractures, and 24 closed fractures. Using the AO classification, there were 16 C2 and 19 C3 fractures. Twenty-one pa-



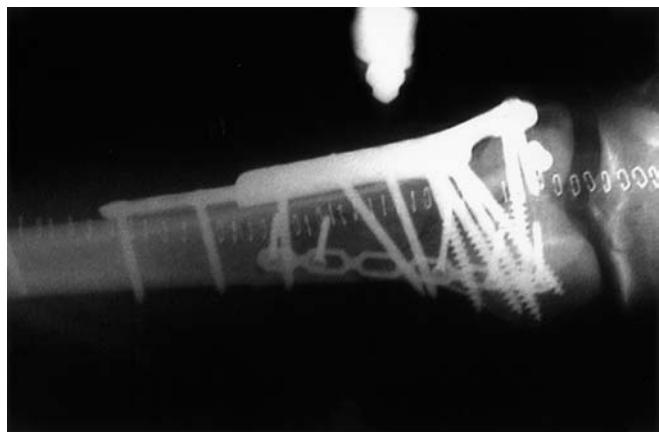
**Fig. 5** View with fixation in place. An anterior plate is easily placed without “medial” dissection. The dissection is limited to that caused by the injury and only what “anterior” exposure is necessary. Often, a modified submuscular placement of the plate is possible with proximal and distal exposures. What medial dissection is needed generally is intraarticular and, if medial collateral and medial capsular structures are preserved, there is little risk of devascularizing the medial articular fragments. Care is taken, however, to minimize the metaphyseal and diaphyseal medial dissection



**Fig. 6** If needed, gentle flexion of the knee joint allows visualization

tients had associated injuries in the extremity. There were 18 blade plates and 18 condylar plates used laterally. Ten reconstruction and 25 DC plates were used anteriorly.

Mean arc of motion was from 5° (range 5°–35°) to 100° (range 20°–130°) flexion. In the three patients with small arcs of motion, physiotherapy was delayed for 6 weeks secondary to access difficulties (insurance authorizations). Five patients required manipulation of the knee under anesthesia to increase range of motion. In all five patients, there were other injuries to the extremities (grade 3 open tibia or ankle injuries requiring free flap) that interfered with their ability to move the knee in the early postoperative period. In all of these patients, final



**Fig. 7** Antero-posterior radiograph of C3 fracture fixed with two plates



**Fig. 8** Lateral radiograph of C3 fracture fixed with two plates

motion was between 0–100 to 70–900. One patient developed a posttraumatic stress disorder that kept her from traveling in a car, and she subsequently received no therapy for 3 months. She ended up with an arthrofibrosis of 0°–20° of motion bilaterally. Excluding these patients, the mean arc of motion for the group was from 1° to 102°.

Reductions were near anatomic (less than 2 mm of step-off, less than 5° of varus, and less than 1 cm of shortening) in all but three patients. Uneventful healing by 16 weeks occurred in 24 of 36 fractures. There were three nonunions. The anterior plate that was utilized for two patients with nonunion (each patient weighing in excess of 350 lb, with long fracture spans) was a long reconstruction plate. Both patients healed after a second procedure. Since then, only 3.5-mm DC plates have been used as the anterior plate, especially with long fracture spans. One of the patients with infection (due to enteric organisms) was doing dressing changes on a superficial wound (originally G-IIIA open) after defecation without hand washing. He underwent debridement and staged reconstruction with subsequent healing. Figs. 7, 8, and 9



**Fig. 9** Clinical result at 12 months. Full weight bearing without pain was possible. Active flexion greater than 120°

show healed radiographs and clinical flexion of one of our patients.

## Discussion

The fixation of complex distal femoral fractures is technically difficult. Surgeons with less experience and training in fracture care presently are prompted to place a retractor medially secondary to difficulties with exposure and reduction; in our opinion, this results in more uncontrolled dissection than intended. Double plating via the anterior approach provides excellent visualization and permits controlled access to the distal femur while minimizing any inadvertent stripping of the medial side. The ability to supplement a lateral plate with an anterior plate increases structural stability in the form of a 90–90 construct. Similar to its application in fixation of the distal humerus, this construct resists deformation in both sagittal and coronal planes. Use of the reconstruction plate was discontinued early in the series, and at present, the preferred anterior plate is a 3.5 mm DC plate, especially with longer fracture planes. The authors acknowledge the increased amount of acute grafting, but in many of these severe fractures there was significant bone loss or comminution. The abundant avail-

ability of allograft and newer inductive agents allowed us to graft acutely without concern for pelvic donor site morbidity or availability. There is no evidence of any adverse effects of acute grafting. There were no additional problems with other perioperative complications using this approach. In the four patients with stiffness, it was felt that extensive damage to the suprapatellar tissues and lack of immediate early motion contributed to fibrosis in this area. Furthermore, an attempt was made to repair the suprapatellar pouch whenever possible to minimize adhesions between the vastus musculature and the bone.

Although the lateral approach is the accepted standard, visualization of the articular surface and indirect reduction can be difficult and, far too often, the approach is not performed as intended – especially in inexperienced hands. The anterolateral approach provides excellent visualization without a biologic cost. An outcome and cost analysis, as well as a comparative study, would help characterize the utility of this approach.

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## References

- Bohlhofner BR, Carmen B, Clifford P (1996) The results of open reduction and internal fixation of distal femur fractures using a biologic (indirect) reduction technique. *J Orthop Trauma* 10: 372–377
- Firoozbakhsh K, Behzadi K, DeCoster TA, Moneim MS, Naraghi FF (1995) Mechanics of retrograde nail versus plate fixation for supracondylar femur fractures. *J Orthop Trauma* 9: 152–157
- Henry SL (2000) Supracondylar femur fractures treated percutaneously. *Clin Orthop* 375: 51–59
- Iannaccone WM, Bennett FS, DeLong WG, Born CT, Dalsey RM (1994) Initial experience with the treatment of supracondylar femoral fractures using the supracondylar intramedullary nail: A preliminary report. *J Orthop Trauma* 8: 322–337
- Koval KJ, Kummer FJ, Bharam S, Chen D, Halder S (1996). Distal femoral fixation: a laboratory comparison of the 95 degrees plate, antegrade and retrograde inserted reamed intramedullary nails. *J Orthop Trauma* 10: 378–382
- Meyer RW, Plaxton NA, Postak PD, Gilmore A, Froimson MI, Greenwald AS (2000) Mechanical comparison of a distal femoral side plate and a retrograde intramedullary nail. *J Orthop Trauma* 14: 398–404
- Tournetta P III, Tiburzi D (1994) Anterograde interlocked nailing of distal femoral fractures after gunshot wounds. *J Orthop Trauma* 8: 220–227